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Changing Conditions in Southwestern Forests and Implications on Land Stewardship



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Changing Conditions In Our Forests

Some assert that Southwestern forests have been almost completely logged, especially of large trees. These statements are not based on documented fact, but rather on individuals' perceptions of what they think they have seen happen. This paper describes changes in tree inventories of Arizona and New Mexico forests between 1962 and 1986. It discusses some implications that these changes may have for land stewardship.

Descriptors include forest acreage by major forest type, total volume of wood, tree size, multi-storied conditions, and forest density.

Total Acreage of Forest Land and Its Distribution by Forest Types

Total forested land in Arizona and New Mexico increased by 573,000 acres, or 5 percent, from 1962 to 1986 (See Table 1, page 4). This increase was due to invasion of coniferous forests into areas such as meadows and woodlands.

Mixed conifer increased by a whopping 1,040,000 acres (81 percent). Ponderosa pine decreased slightly, by 206,000 acres (2 percent). In comparison, the acreage of aspen stands decreased by 222,000 acres (46 percent), despite the increase in total forest area. If this trend continues, the aspen cover type will cease to exist as a distinct cover type in about 25 years. It will persist as a species within mixed conifer stands for extended periods (Pearson, 1931).

It is a good thing that the New Mexico Federation of Women's Clubs prevailed in 1948 to get the State Legislature to choose piñon pine over aspen as New Mexico's state tree (Calabrese, 1993). If aspen had been selected, New Mexico could, in 25 short years, have a state tree that could not be found in stands, but only as scattered, individual trees!

This decline in the amount of aspen and meadows within the mixed conifer zone (predominately white fir, Douglas-fir and ponderosa pine, with Southwestern white pine in some areas) should be considered one of the most pressing environmental concerns in the Southwest today. In 1931, Pearson noted some aspen stands and prairies within the mixed conifer zone lacked young conifers and questioned if they would naturally succeed to mixed conifer. Today, little

evidence of such conditions remains, due primarily to control of forest fires and ecological succession. Ecological succession is the gradual supplementing of one community of plants by another, generally from species that start quickly on bare ground, such as grasses or aspen trees, to shade-tolerant species, such as fir trees.

Extensive areas of aspen stands no longer exist and young conifer stands have matured substantially. Our forest inventories indicate that the remaining aspen stands in the Southwest have an understory of conifers that will eventually replace the aspen. Meadows persist within the mixed conifer type, but they too are being invaded by conifers. None remain as extensive areas that were once described as prairies. Almost all meadows in the mixed conifer zone show evidence of conifer invasion at their margins. Allen (1989) stated that "Overall, in the southeast portion of the Jemez Mountains open montane grassland area decreased 55% from 554 ha in 1935 to 250 ha in 1981. Several small montane grasslands present in 1935 have disappeared, while the larger grasslands have been fragmented." Within the mixed conifer type, Douglas-fir is decreasing and white

fir is increasing (Van Hooser *et al.*, 1992).

Such profound changes in the forest condition are not surprising. The long history of partial cutting, extensive areas of forests reserved from cutting, and successful fire control in the Southwest have allowed ecological succession to increase the number of conifers, especially the proportion of mixed conifer species such as white fir. This is at the expense of successional tree species such as aspen and ponderosa pine (Van Hooser *et al.*, 1992).

Conifer increase and aspen decrease in the absence of fire or harvest are in accordance with ecological studies of mixed conifers and aspen. Neither aspen nor ponderosa pine regenerate under shaded conditions (Pearson, 1931; Pearson and Marsh, 1935; Moir and Larson, 1985 a,b). Ponderosa pine in the Southwest tends to increase in extent and density at its ecotone with grasslands and oak due to grazing and fire control (Covington and Moore 1992).

These trends have increased the potential habitat suitability for the Mexican spotted owl and other species dependent on dense, multi-story stands. The current and projected timber sale

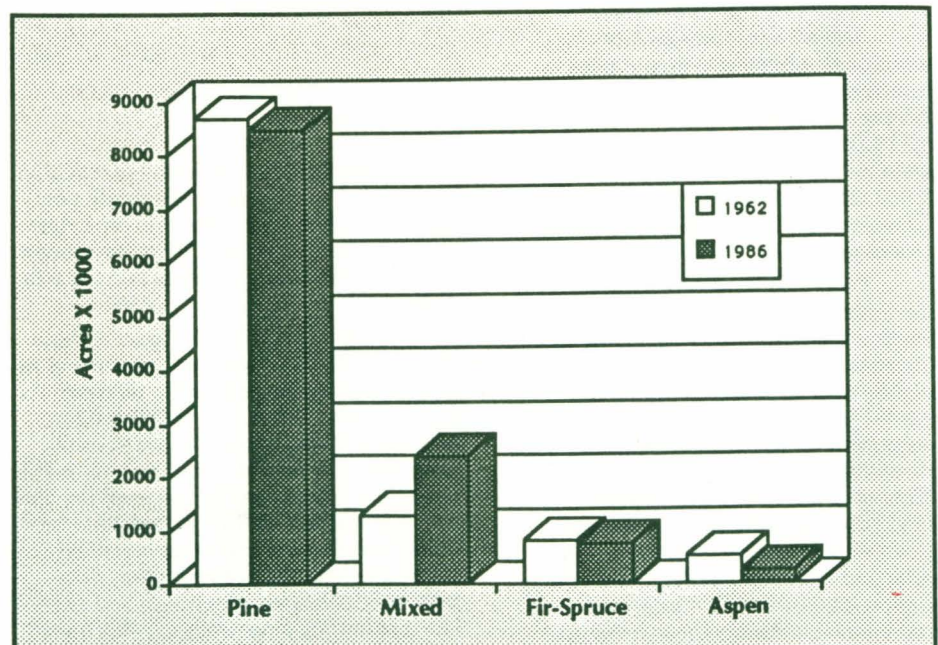


Figure 1. Comparison of forest types in Arizona and New Mexico, 1962 and 1986.

program is too small to mimic the wildfires that had historically maintained the early successional cover types in the Southwestern forest ecosystems.

Total Volume of Wood

Some assert that the Southwest has been logged over, and that the timber industry faces a rapid decline because of over-logging. This is simply not true. Growing stock, or all the wood on trees standing in commercial forests, increased from 1962 to 1986. While forest acreage increased by a modest 5 percent, total tree volume increased by 1,778 million cubic feet (MMCF), or 13 percent. This is despite removal of some 2,200 MMCF (16 percent) of the original volume in the 25-year period. In the national forests, the increase in standing volume was even more pronounced, at 21 percent.

These inventories exclude the additional volume of wood in trees in reserved areas, such as wilderness. Acreage in reserved areas increased 2,119,000 acres, or 232 percent. If we were able to account for growth on the 3,033,000 reserved acres, the volume increases would have been even more pronounced.

Recent national forest sell levels of sawtimber and other products in the Southwestern Region of the Forest Service (Arizona and New Mexico) have averaged slightly over 300 million board feet (MMBF) annually. Sawtimber alone has accounted for about 240 MMBF annually. However, recent timber inventories (Connor *et al.*, 1990; Van Hooser *et al.*, 1992) show that the total net annual growth (gross growth minus mortality and defect) of sawtimber in the Southwestern Region is 701 MMBF. When the timber sale volume is deducted from the total growth, then the net annual increase in

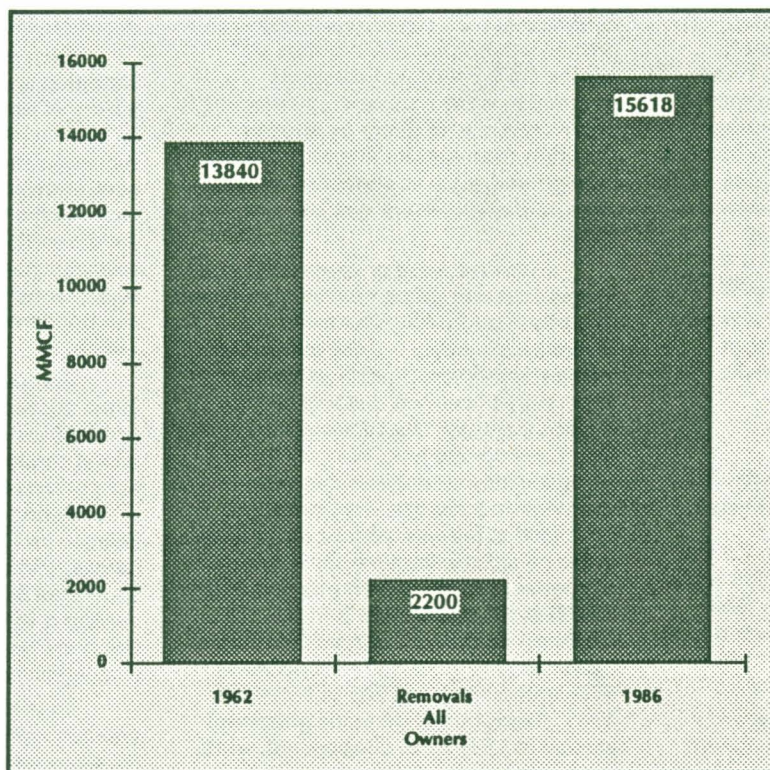


Figure 2. Growing stock volume in 1962, estimated volume removed, and volume remaining in 1986 in Arizona and New Mexico.

volume is 461 MMBF. Thus, statements such as "The days are numbered for the majority of timber industry jobs in this region due principally to over-cutting" are simply untrue in the Southwestern Region.

Tree Size

Another assertion is that practically all trees left in the woods are small, pole-sized trees. However, recent inventories show a different picture. There have been increases in numbers of trees in most size classes.

Data in Table 1 and Figure 3 show that in 1962, there were 8.1 trees per acre over 17 inches (large trees) in diameter breast height (DBH). In 1986, this figure was virtually unchanged at 8.0 trees per acre. The very largest trees, over 20 inches DBH, have decreased by 0.4 trees per acre or 7.4 percent. If we had information on trees in wilderness and other classified areas, this figure could be higher, since there was considerable growth and likely less loss among large trees in wilderness during this same time period.

Other inventories also show an overall increase in large trees. A 1909 inventory on the Kaibab National Forest north of the Grand Canyon (North Kaibab) showed an average of 15 ponderosa pines 16 inches and larger per acre compared to about 27 ponderosa pines in 1989.

In terms of small trees, there has been a dramatic increase in numbers of trees per acre. While an increase in the small-diameter classes probably occurred throughout the century, we have documentation only from 1962 and 1986, when trees from 3 inches DBH to 16.9 inches DBH (Table 1) increased from 132 to 195, or about 48 percent. The total number of trees per acre over one inch in diameter increased from 234 to 294 (26%). Virtually all comparisons of present to historical inventories

show this same trend. The 1909 North Kaibab inventory showed 91 trees per acre 3 inches or less in size. Due largely to fire suppression, this number increased to over 1,100 in a 1989 survey.

Forest Density and Multi-storied Condition

Historical records show many Southwestern forests, especially ponderosa pine, were single-story and sparse and were described in 1904 as open forests. Conditions in what is now the Coconino National Forest were described as follows:

"A yellow-pine forest, as nearly pure as the one in this region, nearly always has an open growth, but not necessarily as lightly and insufficiently stocked as is the case in this forest reserve. The open character of the yellow-pine forest is due partly to the fact that the yellow pine flourishes best when a considerable distance

separates the different trees or groups of trees. It is very evident that the yellow-pine stands, even where entirely untouched by the ax, do not carry an average crop of more than 40 per cent of the timber they are capable of producing. The yellow-pine forest in the reserve is, broadly speaking, a forest long since past its prime and now in a state of decadence. Apparently there has been an almost complete cessation of reproduction over very large areas during the past twenty or twenty-five years (due mostly to sheep use), and there is no evidence that previous to that time, it was at any period, very exuberant." (USGS, 1904).

Such descriptions indicate that the average condition before European settlement were always less dense than today's ponderosa pine forest.

Today's forests have more volume, more trees in nearly every diameter class, and more canopy layers than ever before. Recent research verifies this fact. Dense stands are difficult to maintain in a healthy condition and, in unmanaged

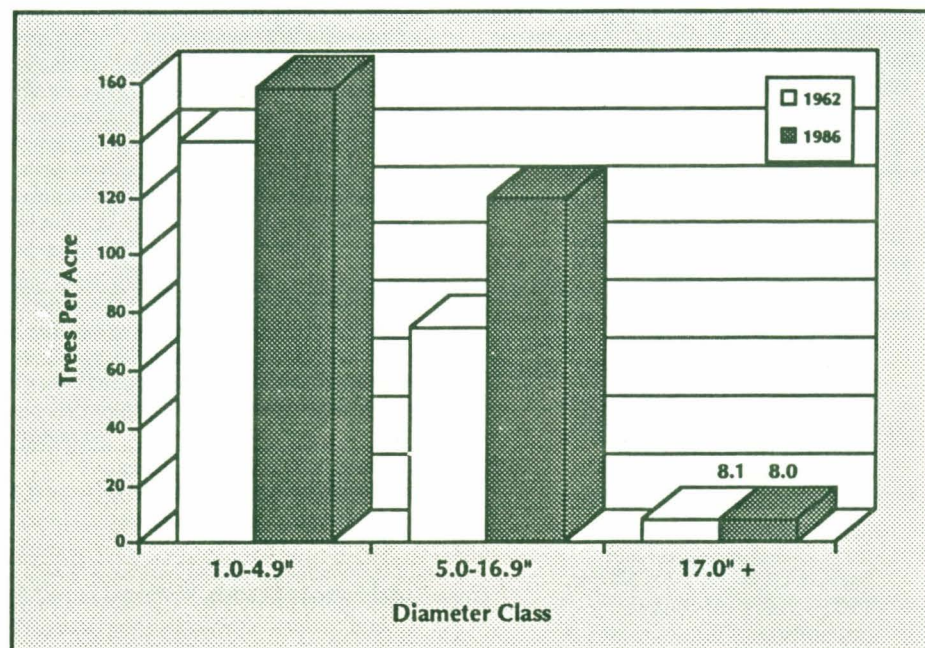


Figure 3. Number of trees per acre by diameter class in Arizona and New Mexico.

condition, are susceptible to catastrophic crown fires and pest/beetle epidemics when they are not properly managed. Covington and Moore (1992) verify these two points:

"Reports from early travelers illustrate the changes in

appearance of the ponderosa pine forest since settlement." Beale, E.F. 1858 report is quoted by Cooper, C.V. 1960 as follows:

'We came to a glorious forest of lofty pines, through which we have travelled ten miles. The country was beautifully undulating, and although we usually associate the idea of barrenness with the pine regions, it was not so in this instance; every foot being covered with the finest grass, and beautiful broad grassy vales extending in every direction. The forest was perfectly open and unencumbered with brush wood, so that the travelling was excellent' (Beale, E.F. 1858).

Cooper (1960) stated that 'The overwhelming impression one gets from the older Indians and white pioneers of the Arizona pine forest is that the entire forest was once much more open and park-like than it is today.'

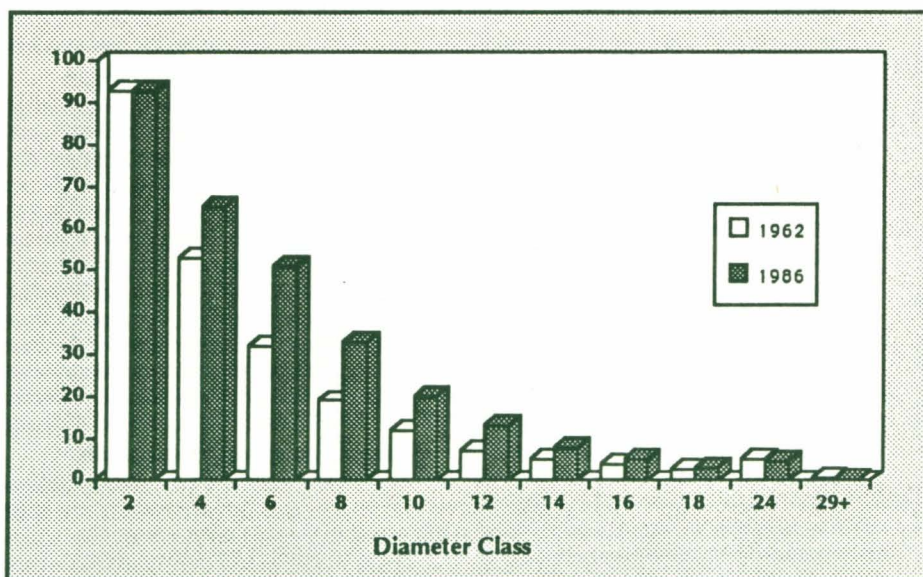


Figure 4. Distribution of trees by two-inch diameter classes on commercial forest lands in Arizona and New Mexico.

"Madany and West (1983) suggested that ponderosa pine seedling survival was probably greater in the early 1900's than in the presettlement days due to reduced competition of grasses (through grazing) with pine seedlings, and the reduced thinning effect that fires once had on seedlings in presettlement times."

"These early descriptions (Whipple 1856 and Beale 1858) of the open nature of presettlement ponderosa pine forests are in agreement with results of recent research which found that canopy coverage by trees of presettlement origin range from 17% (Covington and Sackett 1986), to 22% (White 1985), to 2-31% (Moore unpublished)."

Research by Covington and Moore (1992) shows that the number of trees per acre on the North Kaibab during presettlement was 55.9; in 1990, 276.3; and on the Bar-M area south of Flagstaff, Arizona, the number was 22.8 during presettlement and 851.0 in 1990.

Table 1. Comparison of Timber Inventories, Arizona and New Mexico, All Ownerships

	1962	1986	Differences	Percent Change
Reserved Forest Land, National Forest System (Acres x 1,000)				
	914	2,834	1,920	210
Total Forested Lands, National Forest System				
	7,002	8,068	1,066	15
Acres By Forest Type, All Owners (Acres x 1,000)				
Ponderosa Pine	8,705	8,498	(206)	(2)
Other Conifers (Mixed)	1,278	2,318	1,040	81
Fir-Spruce	692	653	(39)	(6)
Aspen	486	263	(222)	(46)
Total	11,160	11,733	779	5
Growing Stock, MMCF				
National Forest System	8,469	10,258	1,789	21
All Owners	13,840	15,618	1,778	13
Numbers of Growing Stock Trees Per Acre On Timberland, All Species, All Owners				
Inches DBH				
1.0-2.9	93	93	(1)	(1)
3.0-4.9	53	65	12	23
5.0-6.9	32	51	19	60
7.0-8.9	19	33	13	71
9.0-10.9	12	20	8	67
11.0-12.9	7	13	5	70
13.0-14.9	5	8	2	41
15.0-16.9	4	5	1	17
17.0-18.9	2.7	3.0	0.3	10
19.0-28.9	4.9	4.7	(0.2)	(4)
29.0+	0.5	0.3	(0.2)	(32)
Totals	234	294	60	26

Note: These figures are not exactly the same as they occur in the source documents (the Intermountain Research Documents listed in the References). Table 1 has been adjusted based on acreages that had been removed from timberland status between the 1962 and 1980's inventories due to wilderness and other classifications that remove land from the timberland base.

Land Stewardship Implications

Current stands are extremely dense compared to presettlement conditions and are not sustainable in their present state. High tree density is clearly related to susceptibility to bark beetle epidemics (Pearson, 1931; McCambridge *et al.*, 1979; Massey *et al.*, 1977). Significant forest health problems from bark beetles, mountain pine beetle, Western pine beetle, roundheaded pine beetle, Douglas-fir beetle, and Scolytus beetles are certain and tree losses are likely during drought periods when soil moisture is inadequate to support a high density of trees. Also, defoliation by spruce budworm will be a chronic problem. This insect is strongly associated with multi-storied stands of white fir and Douglas-fir throughout the Southwest (Linnane, 1986).

Managing for dense, multi-storied stands in ponderosa pine and Douglas-fir has increased and, if allowed to continue, will increase dwarf mistletoe infection. This parasitic plant spreads by expelling seeds that fall on nearby and understory trees, reducing growth and eventually killing the trees. Small trees never reach large size and stand density is greatly reduced (Hawksworth, 1961).

Two Southwestern Regionwide surveys for dwarf mistletoe conducted 30 years apart indicate that dwarf mistletoe has increased in recent history as forests have become more dense and less stand regeneration has occurred; in the 1950s, 30 percent of the commercial forest was infected and by the 1980s, the infection had reached 39 percent.

High levels of infection eventually eliminate high stand densities and large trees (Hawksworth, 1961). Stands become unsuitable for species such as the Mexican spotted owl, have lower visual quality, and timber productivity is reduced. Open stands of small infected trees can be expected to persist indefinitely until replaced after a stand-destroying event such as fire or clearcutting. If timber cutting, prescribed fire, or natural fire activities are reduced or forgone, dwarf mistletoe infestation can be expected to intensify over time (Parmeter, 1978).

The changed vegetative conditions in Southwestern forests have resulted in dead and down material, insect and disease incidence, and risk of wildfires. Of particular concern is fire in steep, dense, or multi-storied stands of mixed species.

Because of extreme fuel loading, most stands cannot be safely burned to return them to a sustainable condition. In dense stands wildfires are extremely large, hot, and catastrophically destructive to the forest, soil, and endangered wildlife. The most practicable and controllable way to return forests to a healthy, sustainable condition and to maintain and enhance threatened and endangered species habitat is through timber harvest. Thus, the forest management tool best suited to provide long-term health of the forests and for endangered species habitat is tree harvest. Providing jobs and multiple resources is an additional, important benefit of these harvests.

Presently, intensive management is being directed at improving habitat for Mexican spotted owls by promoting dense, multi-storied stands. This will continue to accelerate movement of tree stands toward more dense conditions and increase the probability, extent, and intensity of wildfires beyond what we now experience in the Southwestern mixed conifer and portions of the ponderosa pine forests. Where timber and fuel management activities are forgone, wildfire losses can be expected to be higher than would otherwise occur.

The current low level of harvest and cultural (pre-commercial thinning) treatments cannot prevent aging and increasing small-tree density of Southwestern forests. They will become older, denser, and perhaps more extensive. However, at some point, ecological limits will be reached, resulting in extensive forest destruction from insects, diseases, and fires. Similar losses are well-documented throughout the interior West where the same circumstances have prevailed, such as most recently in the Blue Mountains of eastern Oregon.

Forest management concerns attributed to fire exclusion, resulting in increased tree density in ponderosa pine forests include overstocked sapling patches; reduced tree growth; interrupted nutrient cycles; increased disease, insect infestation, and parasites (e.g., root rot, bark beetle, dwarf mistletoe); decreased forage quality and quantity; increased fuel loading; increased vertical fuel continuity due to dense sapling patches; increased severity and destructive potential of wildfires; increased tree canopy closure;

decreased on-site water availability; decreased stream-flow and ground water recharge; shifts in habitat quality for biota; decreases in some important forest types; decreases in early successional plant communities; and visual unattractiveness.

Many of the above are applicable in mixed conifer also.

There are many social, economic, and politically imposed factors that have contributed to developing forest health problems, which effectively limit treatment of the forest as a whole to improve its health. These factors include:

- Fire prevention and control.
- A budgeted sale program of 310 MMBF.
- Mexican spotted owl guidelines.
- Almost no use of clearcutting.
- Visual quality objectives.
- Smoke management guidelines.
- Forest plan standards and guidelines.
- Large increases in reserved areas such as wilderness.
- Limited budget for precommercial thinning.
- Meager market for small trees (5-9" DBH).
- Protection of threatened and endangered species (thistles, salamanders, etc.).

These limitations are unlikely to change in the near future and they reduce options for the amount of treatment possible.

What Can be Done?

We should start where potential ecological effects are most profound. Correction of forest health problems requires rigorous analysis and careful planning and must be considered in light of the total ecosystem. Some approaches that appear to merit implementation include:

- Increase regeneration of aspen, including large blocks.
- Harvest around urban interface.
- Establish Integrated Pest Management demonstration areas.
- Wilderness fire programs.

- Prompt salvage of major mortality when it does occur.
- Reduce incidence of white pine blister rust in Lincoln National Forest.
- Re-establish ponderosa pine in selected portions of the white fir habitat type
- Aggressive harvest of small trees.
- Intensive precommercial thinning program.
- Increased prescribed fire program.
- Revise Forest plan standards and guidelines as needed, based on new information and new management, such as management under the Northern goshawk guidelines.

Aggressive implementation of the Northern goshawk management guidelines, designed with forest health in mind, would lead to forests that are sparser and more like presettlement conditions. These forests would be easier to maintain in a healthy condition. We will need to resolve conflicts between

Northern goshawk management guidelines and current Mexican spotted owl management guidelines, which can lead to very unhealthy forests in the long run.

Through the Forest Service Ecosystem Management Scientific Committee, we can work toward modification of the Northern goshawk guidelines to make them even better for forest health.



Conclusion

Assertions about decline in Southwestern forests due to timber harvesting are not based on fact. The data show that tree density, volume, and number of canopy layers increased between 1962 and 1986. Fir is increasing at the expense of aspen and ponderosa

pine. The number of large trees has remained about the same during this period. Unsustainable forest changes are largely due to reduced incidence of fire during the last 100-plus years and failure to replace fire with timber harvest, especially in the small and mid-size

diameter classes. Rather than move toward less disturbance as has been the trend in the recent past, it is vitally important that we address the unsustainable situations created by type conversions and extremely dense forests of today.

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